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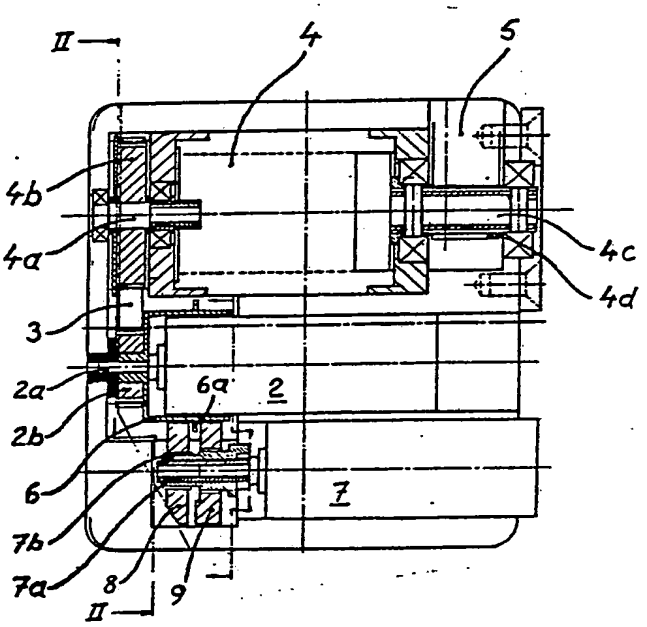
(54) Title: A METHOD AND A DRIVE ASSEMBLY FOR OPERATING AND LOCKING COMPONENT MEMBERS OF ELECTRICALLY OPERATED PROSTHESES, MANIPULATORS AND LIKE DEVICES

(57) Abstract

A drive unit for electrically driven prostheses, manipulators and the like, for example, the gripping members of an artificial arm or industrial robot, comprises an electrical drive motor (2) having an output shaft which drives an active component, for example a gripping means, via a transmission arrangement (4). The output shaft (7a) of a brake-motor (7) has arranged thereon a sleeve provided with a part having a right-hand screw thread and a part having a left-hand screw thread in engagement with brake means such as shoes (8, 9) which upon activation of the brake-motor engage a brake disk (6a) connected to the output shaft (2a) of the drive motor. The brake-motor is activated upon completion of the movement of the drive motor and therewith locks the active component in the position to which it has been moved without the occurrence of play.



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A method and a drive assembly for operating and locking component members of electrically operated prostheses, manipulators and like devices

Field of Invention

The present invention relates to a method of operating and locking component members of electrically operated prostheses, manipulators and like devices, such as the gripping elements of artificial arms and robots in which there is used a drive motor from which movement is transferred to said component member via transmission means for the purpose of effecting movement of said member.

The invention also relates to a drive assembly for use when carrying out the method.

Prostheses are often operated with the aid of so-called myo-signals, which involve the placing of electrodes in the region of the muscles to be used in effecting a given movement of the prosthesis. Upon activation of the muscle there is generated an electric signal which is captured by the electrode and utilised to activate the prosthesis drive unit.

Various types of active components in orthosis/prosthesis for upper and lower extremities are controlled with the aid of myo-signals. Hand hook and elbow constitute examples of such active components.

The invention can also be applied, however, to various kinds of manipulators and like devices, for example robotic gripping means, with which control signals other than myo-signals are used.

Background Art

Various kinds of prostheses drive systems are known to the art. For example, there is described in

Austrian Patent Specification No. 338,410 (Viennatone) a gear mechanism for an orthosis, prosthesis or like device in which drive movement is effected with the aid of a left-hand and a right-hand thread. DE-A-24 26 787 (Forschungsinstitut für Orthopädie-Technik) describes a safety device for an artificial hand with which there is used a separate latching means for holding the fingers of the prosthesis in their closed position.

One serious disadvantage with previously known prostheses of this and similar kinds in which a drive motor is controlled to produce movement in the artificial component is that it is not possible to obtain distinct positioning of the active component. The cause hereof is related to the intrinsic inertia of the system, which prevents the component from being stopped in precisely the correct position. A further, related disadvantage is that it is not possible to eliminate play in the known prosthesis. Neither is it possible as a rule to readily prize or force a prosthesis which has inadvertently locked, this possibility being of extreme importance with most types of prostheses. As will be understood when a prosthesis locks in a certain position and cannot be readily prized free, the attempts made to force the prosthesis may result in serious damage and injury.

Another disadvantage encountered with the majority of hitherto known prostheses is that in order to function satisfactorily they must be manufactured to extremely accurate tolerances.

Object of the Invention

Accordingly one object of the invention is to provide a method of the aforesaid kind which avoids the aforementioned disadvantages encountered with known drive systems and which enables the active elements of the prosthesis to be positioned accurately without losing, for example, the gripping power of such elements as a

result of play in the prosthesis or the like.

A further object is to provide a drive system of the aforesaid kind which enables the active component to be readily prized free or forced even when in a locked position.

Another, important object is to provide a drive system for prostheses, manipulators and like devices which can be controlled electronically in a simple and reliable fashion and which can thereby be adapted more readily to the varying requirements demanded in certain contexts, for example, to different patient categories and the environment in which a robot is to work.

A further object is to provide an operationally reliable drive and control system which can be manufactured without requiring accurate manufacturing tolerances in respect of the different components of the device.

Brief Disclosure of the Invention

These and other objects are fulfilled by a method according to the invention which in its widest aspects is characterized by in addition to the drive motor also using a brake-motor and activating said brake-motor during the final stage of movement for locking said component member in the position to which it has been moved, or subsequent to the completion of said movement.

The use in accordance with the invention of a separate brake-motor which produces precise locking of the active component in an adopted position enables the active component to be positioned or oriented in a distinct and play-free fashion. The brake-motor also enables the active component member to be forced free when so required. The separate electric motors for effecting the respective driving and locking movements means that the arrangement as a whole can be given a simple and robust form, which in turn results in a reliable function without requiring manufacturing

tolerances.

Normally the drive movement is obtained through a series-motor, and consequently the applied current will increase when movement of the active component meets with resistance, for example, when said component grips an object. In a preferred embodiment of the invention this fact is utilised to guide the brake-motor, by arranging for said motor to be activated when the strength of the current supplied to the drive motor exceeds a given value.

Alternatively, a brake-motor start signal can be transmitted when the movement of the active component ceases or begins to cease, for example, when gripping an object.

In one particular application of the invention for guiding and controlling prostheses in which myo-signals are used in a known manner to control movement of the drive motor, such myo-signals are also used to control the brake-motor. This affords particular advantages when the brake-motor is to be activated to release the active component from a locked position, i.e. the brake-motor is caused to rotate in a direction opposite to the rotational direction in which the locked state was achieved.

The invention also relates to a drive assembly for operating electrically operated prostheses, manipulators and the like, for example the gripping elements of artificial arms and robots, the drive assembly including an electric drivemotor having an output shaft, a transmission means for transmitting movement of the output shaft to a drive shaft associated with an active component member, for example a gripping instrument, said drive unit being characterized by an electrically operated brake-motor having an output shaft which co-acts with brake means arranged to lock the active component in an adopted position by engagement with an element operatively

connected to the drive-motor output shaft, and in that control means are provided for activating the brake-motor in the latter stages of the movement of said active component or subsequent to the completion of said movement.

In the case of an embodiment preferred in practice the brake-motor output shaft carries a sleeve having a part provided with a right-hand screw thread in self-braking engagement with one brake means such as a shoe, and a part provided with a left-hand screw thread in self-braking engagement with another brake means such as a shoe.

This provides a mechanically simple and reliable arrangement capable of rapidly applying powerful braking forces.

The self-braking or irreversible features of the screw threaded sleeve parts means that the braking force will be maintained despite interruption of the drive current to the brake-motor immediately the brake means have been applied, thereby minimising the current consumed by the drive and brake units.

One problem with the described arrangement, however, is that the torque generated by the brake-motor is normally not sufficient to release the brake means such as shoes when reversing the direction of rotation.

This problem is solved, however, with a preferred embodiment of the invention by providing on the brake-motor shaft an eccentric abutment element which when rotating the brake-motor shaft in the opposite direction moves through a dead space corresponding to approximately half of a revolution and then exerts an impact force on an element associated with the aforesaid shaft sleeve. This impact force is sufficient to break the self-braking effect, whereafter the brake means can be moved to their release position without difficulty.

In accordance with another embodiment of the

invention the drive-motor output shaft has arranged concentrically thereon a brake drum having a brake disk against the brake shoes engage. Despite its simplicity in design, a disk brake of this kind is highly effective.

Furthermore, the brake drum shaft may partially enclose the drive motor, which in practice means that the two motors, namely the drive motor and the brake-motor, are positioned close to one another, thereby utilising the space available in the best possible manner, this space normally being restricted in a prosthesis of the kind in question. In other words the invention provides a particularly compact drive and brake assembly.

In order to provide for effective control of both drive and brake-motors, the control means may include a sequence part having two or more derivation units for applying and releasing the brake at a desired moment in time, and one or more delay circuits arranged to prevent movement of the drive motor before the brake has been released and to prevent play before the brake has engaged.

Derivation units and delay circuits of the aforesaid kind constitute simple and inexpensive electronic components, which can be used to advantage in a drive and brake assembly according to the invention.

In addition to prostheses a drive and brake assembly according to the invention can also be used to advantage in many other contexts, for example, with various types of manipulator, such as robots and like devices. In this case the control signals used to activate the two motors are normally produced from a different source, insomuch as myo-signals are not used to control said motors.

The invention will now be described in more detail with reference to an embodiment thereof illustrated in the accompanying drawings.